

## **Historic, Archive Document**

Do not assume content reflects current scientific knowledge, policies, or practices.



Reserve  
aSB608  
.A515H45  
1996



United States  
Department of  
Agriculture



Forest Service

Forest Health  
Protection

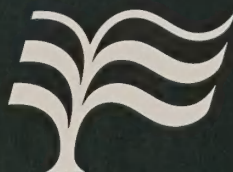
Forest Health  
Technology  
Enterprise Team-  
Davis  
2121C Second Street  
Davis, CA 95616

# Hennigan Orchard Study 1996 - Continued Evaluation of *Bacillus thuringiensis* to Control Peach Twig Borer

## Study Plan

February 1996

United States  
Department of  
Agriculture



## NATIONAL AGRICULTURAL LIBRARY

Advancing Access to  
Global Information for  
Agriculture

Pesticides used improperly can be injurious to human beings, animals, and plants. Follow the directions and heed all precautions on labels. Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides where there is danger of drift when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment, if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

**NOTE:** Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your local forest pathologist, county agriculture agent, or State extension specialist to be sure the intended use is still registered.



February 1996

Hennigan Orchard Study 1996 -  
Continued Evaluation of  
*Bacillus thuringiensis*  
to Control Peach Twig Borer

Cooperators:

John W. Barry, USDA Forest Service  
Gary Kirfman, Abbott Laboratories  
Bob Hennigan, Hennigan Orchards  
Frank Zalom, University of California  
Joe Connell, Butte County Farm Advisor  
Russ Stocker, Arena Pesticide Management

---

USDA Forest Service  
Forest Health Technology  
Enterprise Team-Davis  
2121C Second Street  
Davis, CA 95616  
(916)757-8341  
FAX (916)757-8383





## STUDY PLAN

### Hennigan Orchard Study 1996 - Continued Evaluation of Bacillus thuringiensis to Control Peach Twig Borer

## INTRODUCTION

### Background

California produces virtually all of the almonds in the United States and over half of all the almonds in the world. Over half of the production is for export to other countries. Several insect pests injure almond trees or nuts, but the most important for most growers are navel orangeworm, peach twig borer and San Jose scale. Navel orangeworm is typically controlled by cultural methods and, when needed, a hull split spray of an organophosphate insecticide. Peach twig borer and San Jose scale are typically managed with a dormant season application of an oil and an organophosphate insecticide (usually diazinon, chlorpyrifos or methidathion). Most applications are made by ground with an orchard sprayer, but some are made by air. The dormant spray has been the recommended control for peach twig borer in almonds, peaches, nectarines, apricots, plums and prunes during the past 19 years. It was thought to be non-disruptive because it is applied at the time of the year when the natural enemies of other insects and mites are not present in the orchards, and it was therefore been considered an important integrated pest management tactic.

Recently, the use of organophosphate insecticides in dormant sprays has been questioned because of implication in poisonings of the red tailed hawk, an important raptor in the central valley, and in runoff into waterways. As a result, regulatory agencies have been examining the registration of organophosphate insecticides for use in the dormant season, and their use may be eliminated or severely limited in the future.

Our work targets the peach twig borer because its feeding results in direct damage to the nuts. If left untreated, damage to almonds can exceed 30%. Before synthetic organic pesticides were available, the peach twig borer was considered to be the most important insect pest of almonds. It is believed that if conventional pesticides could be eliminated from the almond production system, the San Jose scale might be brought under satisfactory natural biological control in most instances.

Application of Bacillus thuringiensis (Bt) have been shown to be effective in controlling peach twig borer in recent studies conducted by the University of California, Abbott Laboratories, and cooperating agencies. Over the past two years it has become operational and commercialized for control of peach twig borer in California.





Bt timing for first generation PTB larvae has been based upon foliage development. The first treatment has been at "popcorn" stage and the second at "petal fall." Abbott Laboratories is recommending timing based upon percent emergence from the hibernacula as listed under methods section.

In addition to the bloom time Bt applications for the overwintering larvae, Bt's can be applied for the first generation larvae. The timing for the "May" sprays is determined by degree day calculations. Following the bloom sprays, a pheromone trap is placed in the field to determine the onset of adult flight activity. Application timing for the May spray is provided on page 68, of the publication by University of California (1984).

Most of the research to date has been with ground applications. Although a significant amount of almond acreage could use ground applications, some growers must apply the treatments by air if the ground is too wet for ground equipment or if their orchards are too large to complete ground application during the critical timing window.

The background discussion above was adopted from Frank Zalom (Zalom, et al. 1994) and from discussions with Gary Kirfman, Abbott Laboratories.

The 1994 Hennigan study results have been analyzed and a report drafted. A poster Bloomtime Aerial Application of Bacillus thuringiensis for Control of Peach Twig Borer was presented at the Second National Integrated Pest Management Symposium / Workshop (Zalom, et al. 1994). The 1994 study demonstrated that aerial applications of Bacillus thuringiensis (NOVO Biobit HPWP applied at 1 lb./acre) during bloom using conventional nozzles and either 5 gal./acre or 15 gal./acre dilution, provided significant control of peach twig borer emerging from hibernaculae relative to the untreated control.

Additional field trials, however, are needed to demonstrate that other Bt formulations (in this case Dipel ES) applied in a 5 gallon per acre tank mix, is as biologically effective as other formulations and higher application rates (and more diluted) tank mixes.

### Objective

To demonstrate the efficacy and coverage of the bioinsecticide Dipel ES applied at one quart per acre in 4.75 gallons of water (total of 5 gallons per acre) to control peach twig borer.

### Scope

This study will be conducted at the Hennigan Almond Orchard, Chico, CA, during February - March 1996. The orchard will be treated during February and March. The bioinsecticide, Dipel ES, will be applied by small helicopter at one quart per acre. The tank mix will be one quart Dipel mixed in 4.75 gallons of water. A food coloring dye will be added for the spray deposition measurements. Spray deposit collections will be made in the orchard and canopy to assess spray coverage. Biological effectiveness will be assessed by



counting pupae in cardboard trunk traps and by counting twig strikes from the small replacement trees adjacent to designated spray deposit sampling trees. A total of six plots will be treated (the same plots for each of the two treatments) and there will be two control plots. None of the plots will be treated by any other sprays until after the cardboard wraps are removed and the strike counted. Abbott Laboratories is considering treatment of additional plots with 20 gallons per acre and/or ground treatment for a comparison.

## METHODS

### Study Design and Application

None of the designated study plots have been treated with dormant sprays this season. Plots numbered 1, 10, 18, 5, 17, and 13 designated in Figure 1, located north of Anita Rd., Chico, CA, will be treated when 20-40% of the larvae have emerged from hibernacula and a few days later when 80-100 have emerged by Bob Hennigan will apply the spray using his Robertson R-22 with a tank capacity of 20-25 gallons. The application will be north to south and south to north applying the spray over each row of trees. Dipel ES (see label attached) will be applied at one quart per acre in 4.75 gallons of water. A food coloring dye will be added. The aircraft will be calibrated on a swath width of 24 feet to apply 5 gallons per acre total spray flying over every tree row.

Plots will be treated in pairs following the schedule as listed:

<u>Time</u>	<u>Plots</u>
0800	1 & 5
1200	10 & 13
1500	18 & 17

Plot 6 is a buffer from prior treatments to orchards located to the west. Plots 14 and 9 are control plots. It is essential to maintain the integrity of the control plots (14 and 9) and to insure no drift into these plots. Plots 4 and 21 are candidates for other treatment regimes. Information on application, timing, and meteorology will be recorded during the spraying.

### Biological Sampling and Assessment

The effect of treatments on peach twig borer will be assessed in two ways. First, all scaffolds from at least five trees in the center rows of each treatment will be encircled with cardboard bands stapled to the bark in early March. During March, larvae on the trees will crawl down the scaffold to find secluded places for pupation. It is believed that the larvae will pupate in the cardboard bands. The bands will be removed from the trees in early April before the adults emerge. Adult emergence will be determined using pheromone traps placed in the orchard. The bands will be returned to the laboratory at





UC Davis and will be dissected to remove and count the relative number of pupae remaining in the treated and untreated plots. A second method of assessing peach twig borer populations will be by counting the number of shoot strikes in early April that resulted from feeding of overwintering larvae emerging from their hibernacula. Shoot strikes and survivors in cardboard will be assessed on replanted trees from the center of each of the plots. Replant trees will be used for this assay because their shoot growth is more vigorous than on the older trees in the orchard making it easier and more accurate to determine the number of shoot strikes. (Zalom, et al. 1994)

### Spray Deposit Sampling

The spray will be monitored with Kromekote cards placed in the tree canopy and near the ground beneath the tree dripline of each of the five designated sampling trees (Figure 2), in the six treatment plots and two control plots. Purpose of this sampling is to determine the quality of application and spray deposition coverage, and to assess canopy penetration and coverage. The aim is to place as much spray and as evenly as possible into the canopy and not on the orchard floor. The 1992 study demonstrated excellent crown coverage when undiluted Bt was applied by Ag Cat and Micronairs and in 1994 using conventional spray at 5 gpa. Spray coverage, however, was better at "petal fall" when there was more foliage thus more canopy turbulence. We expect to observe a similar phenomena on this study.

Kromekote cards measuring 8 x 11 cm will be wrapped on sides of aluminum soft drink cans. Also a Kromekote cut square measuring 6.3 x 6.3 cm will be attached to the top of each can. The cans will be extended (Figure 2) by 1/2" thick-walled PVC pipe. There will be one on the east and another on the west side of the crown (Figure 2) extending up from the ground with one at 12 feet and another at 25 feet. Table 1 is a listing of spray deposit sampling equipment. Additionally there will be a can extended on PVC 18" above the ground at the drip line on the east and west sides of each sample tree. Cards will be positioned the morning of the scheduled spray day and retrieved the same day of treatment after spraying. Cards will be marked as shown in Table 2.

The tank mix will contain an FD&C food color dye to aid in assessment of spray deposition and for the purpose of monitoring drift from one plot to another. The cards will be assessed for number and size of drop stains and spray volume.

Spray drift sampling may be conducted with cards placed directly on the ground downwind of the treatment plots subject to resources and time availability.

### Weather Monitoring

Wind speed, wind direction, temperature (dry and wet bulb) will be made at the beginning and end of spraying at each plot. The measurements will be made at the 2-meter level both in the canopy and outside the canopy. In addition temperature will be measured at canopy top by extending thermometers on PVC pipe.



## CONTRIBUTIONS

Bob Hennigan - Hennigan Almond Orchards (916)-893-8492  
(916)-891-1862

- . Provide orchard plots for study
- . Provide spray helicopter and pilot

Gary Kirfman - Abbott Laboratories (916)-668-1495

- . Provide Dipel ES
- . Assist in field operations

Frank Zalom - University of California IPM Program (916)-752-8350

- . Coordinate the biological assessment
- . Provide field crew support

Jack Barry - USDA Forest Service (916)-757-8342

- . Prepare study plan
- . Coordination of participants
- . Provide for spray deposit sampling and analyses
- . Coordinate data analyses and reporting
- . FD&C food coloring dye

Joe Connell - Butte Co. Farm Advisor (916)-538-7201

- . Coordination with Butte County Agricultural Commissioner
- . Mark plots
- . Assist in field operation
- . Assist Frank Zalom in biological assessment

Russ Stocker - Arena Pesticide Management (916)-757-1550

- . PVC poles
- . Consultations





## REFERENCES

- Roltsch, W.J., F.G. Zalom, J.W. Barry, G.W. Kirfman, and J.P. Edstrom. 1995. Ultra-low volume aerial applications of Bacillus thuringiensis var. kurstaki for control of peach twig borer in almond trees. Applied Engineering in Agriculture 11(1):25-30.
- Zalom, F., J. Barry, W. Johnson, G. Kirfman, J. Conley, and J. Connell. 1994. Bloomtime aerial applications of Bacillus thuringiensis for control of peach twig borer. Presented at the Second national integrated pest management symposium/workshop. Las Vegas, NV.
- Zalom, F., B. Hennigan, J. Connell, G. Kirfman, J. Conley, C. Kitayana, H. Thistle and J. Barry. 1994. Study plan - Hennigan Orchard study 1994 - Evaluation of Bacillus thuringiensis to control peach twig borer. Report No. FPM 94-4. USDA Forest Service Forest Pest Management: Davis, CA.
- University of California. 1984. Integrated Pest Management for Almond Orchards. Pub. 3308. Statewide Integrated Pest Management Project, Division of Agriculture and Natural Resources, Davis, CA.



20 trees

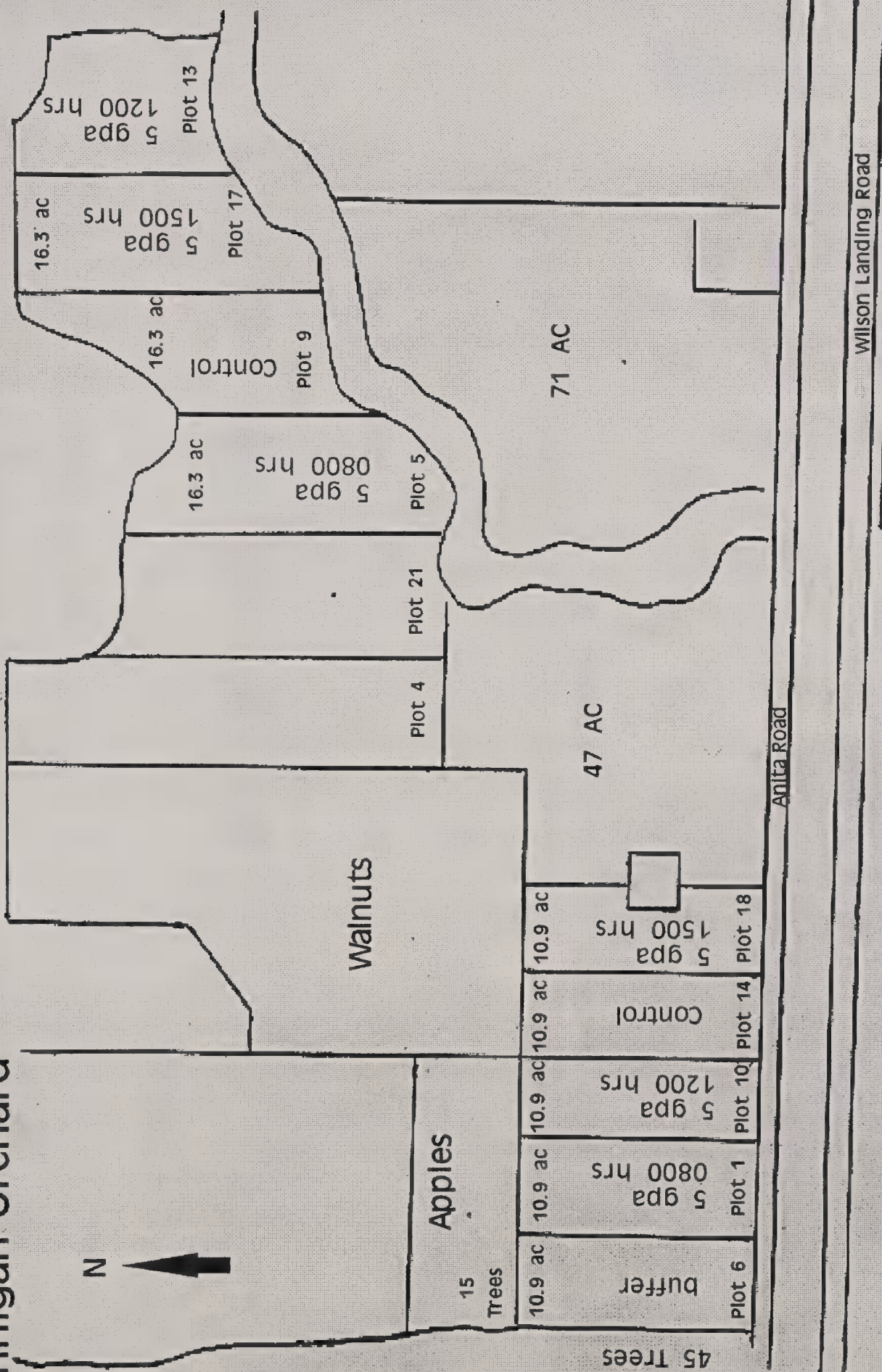


Figure 1 - Plot diagram, Hennigan orchard study, 1996





**Figure 2 - Spray deposit sampling**

***Hennigan Orchard  
Study, 1996 -  
Continued  
Evaluation of  
*Bacillus thuringiensis*  
to Control Peach  
Twig Borer***

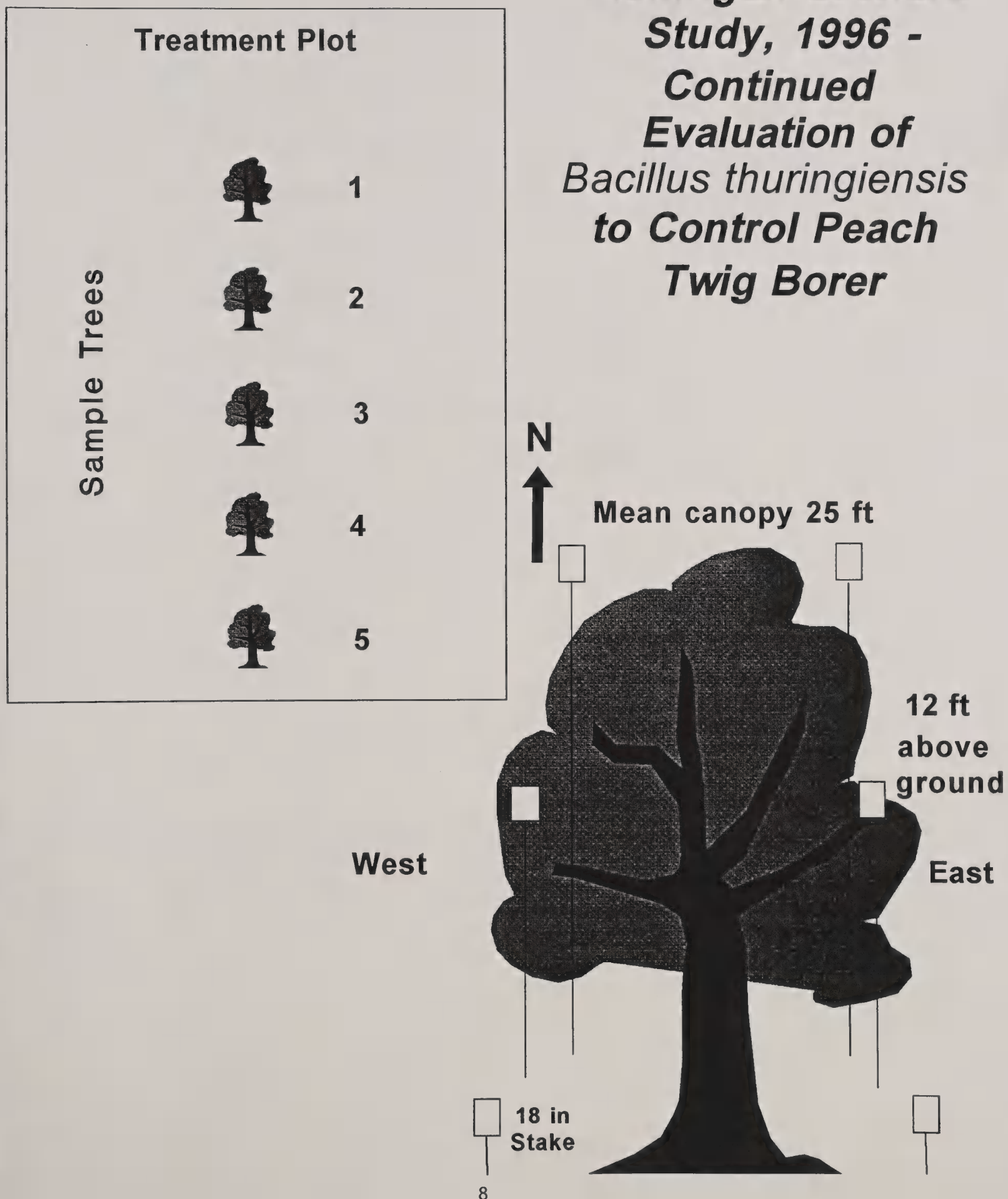




Table 1 - Spray deposit sampling equipment, Hennigan Orchard Study, 1996

Cans, Poles, and Stakes Required  
Sample Trees

1.	Plots to be treated and monitored are:	
	1, 5, 9, 10, 13, 14, 17, 18 =	8 Total Plots
2.	Five sample trees per plot (5 x 8) =	40 Total Sample Trees
3.	Each tree has 4 long poles (4 x 40) =	160 Total
4.	Each tree has 2 stakes (2 x 40) =	80 Total
5.	Cans per day treatment =	280 Total
6.	Kromekote cards per day treatment	280 Total
	Side Can	280 Total
	Top Can	280 Total

Drift

---

Note: Same set-up for the "popcorn" and "petal fall" treatments.





Table 2 - Card/Can marking method, Hennigan orchard study, 1996.

Plot Nos. (1, 5, 9, 10, 13, 14, 17, 18) (Note there are 6 plots 2 of which are untreated controls)

Tree Nos. (1-5)

Canopy (CW or CE) (Canopy West or Canopy East)

Mid-Canopy (MW or ME) (Mid-Canopy West or Mid-Canopy East)

Ground (GW or GE) (Ground West or Ground East)

(EXAMPLE)

1 - 1 - CE

| | |  
| | |

Plot Tree No. Canopy East

#### Plots

9 and 14

Control plots

1, 5, 10, 13, 17, 18

Popcorn and petal fall spray - treatment plots

#### Spray Deposit Sample Trees

1-5 in each plot



# DiPel® ES

**Biological Insecticide  
Emulsifiable Suspension**

**Active Ingredient:**

<i>Bacillus thuringiensis</i> , subsp. <i>kurstaki</i> .....	3.5%
Inert Ingredients .....	96.5%
Total .....	100.0%

**Potency:**

17,600 International Units per mg of product or 64 billion International Units per gallon of product.

**Potency units should not be used to adjust use rates.**

E.P.A. Registration No. 275-65

E.P.A. Est. No. 33762-IA-1

List No. 5555

**INDEX:**

- 1.0 Statement of Practical Treatment
- 2.0 Precautionary Statements
  - 2.1 Hazards to Humans (and Domestic Animals)
  - 2.2 Personal Protective Equipment
  - 2.3 User Safety Recommendations
- 3.0 Directions for Use
- 4.0 Agricultural Use Requirements
- 5.0 Non-agricultural Use Requirements
- 6.0 Storage and Disposal
- 7.0 Application Instructions
- 8.0 Ground and Aerial Applications
  - 8.1 Mixing Recommendations
  - 8.2 Spray Volume Recommendations
- 9.0 Application Rate for Corn
- 10.0 Application Rate for Cotton
- 11.0 Application Rate for Peanuts
- 12.0 Application Rate for Alfalfa, Hay and Other Forage Crops
- 13.0 Application Rate for Sunflowers
- 14.0 Application Rate for Other Crops
- 15.0 California Crops Application Rates
- 16.0 Application Rate for Small Spray Volumes
- 17.0 Notice to User

**KEEP OUT OF REACH OF CHILDREN**

**CAUTION**

## 1.0 STATEMENT OF PRACTICAL TREATMENT

In case of contact, immediately flush eyes or skin with plenty of water. Get medical attention if irritation persists.

## 2.0 PRECAUTIONARY STATEMENTS

### 2.1 Hazards to Humans (and Domestic Animals)

Avoid contact with skin, eyes or clothing.

### 2.2 Personal Protective Equipment

Some materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for category E on an EPA chemical resistance category selection chart.

Applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Chemical resistant gloves, such as barrier laminate, or nitrile rubber, or neoprene rubber, or viton
- Shoes plus socks

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

### 2.3 User Safety Recommendations

User should:

- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

## 3.0 DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

## 4.0 AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE), and restricted entry intervals. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

#### 4.0 AGRICULTURAL USE REQUIREMENTS (cont.)

Do not enter or allow worker entry into treated areas during the Restricted Entry Interval (REI) of 12 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water is:

- Coveralls
- Chemical resistant gloves, such as barrier laminate, or nitrile rubber, or neoprene rubber, or viton
- Shoes plus socks

#### 5.0 NON-AGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

Do not enter treated areas without protective clothing until sprays have dried.

#### 6.0 STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

##### Storage:

Keep containers tightly closed when not in use. Do not store at temperatures greater than 100°F. Roll or shake the drum before dispensing.

##### Pesticide Disposal:

Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. Do not contaminate water when disposing of equipment wash waters.

##### Container Disposal:

Triple rinse (or equivalent). Then puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

#### 7.0 APPLICATION INSTRUCTIONS

##### MODE OF ACTION:

After eating a lethal dose of DiPel ES, larvae stop feeding within the hour, and will die within several days. Dying larvae move slowly, discolor, then shrivel, blacken and die.

DiPel ES is a highly selective insecticide for use against listed caterpillars (larvae) of lepidopterous insects. Close scouting and early attention to infestations is highly recommended. Larvae must eat deposits of DiPel ES to be affected. Always follow these directions:

- Treat when larvae are young (early instars) and before economic thresholds of damage have been exceeded.

- Larvae must be actively feeding on treated, exposed plant parts.
- Thorough spray coverage is needed to provide a uniform deposit of DiPel ES at the site of larval feeding. For some crops directed drop nozzles by ground machine are required.
- Under heavy pest population pressure, use the higher label rates, shorten the spray interval, and/or increase spray volume to improve coverage.
- Tank mixes with a contact insecticide may enhance control.
- Repeat applications at an interval sufficient to maintain control, usually 3 to 14 days depending on plant growth rate, moth activity, rainfall after treating, and other factors. If attempting to control a pest with a single spray, make the treatment when egg hatch is essentially complete, but before extensive crop damage occurs.
- A spreader-sticker or surfactant which has been approved for use on growing and harvested crops should be added for hard-to-wet crops. (Not recommended for chemigation.)
- DiPel ES is a non-restricted use pesticide and does not require a restricted use permit for purchase or use.

#### 8.0 GROUND AND AERIAL APPLICATIONS

DiPel ES may be applied in ground, aerial equipment, or sprinkler irrigation systems, with quantities of water sufficient to provide thorough coverage of infested plant parts. The amount of water needed per acre will depend on crop development, weather, application equipment, and local experience.

Do not spray when wind speed favors drift beyond the area intended for use.

##### 8.1 Mixing Recommendations

**Important** - Do not add DiPel ES to the mix tank before introducing the desired quantity of water. Start the mechanical or hydraulic agitation to provide moderate circulation before adding DiPel ES. Add the desired volume of DiPel ES to the mix tank and continue circulation. Include rinse water from the container. Maintain the suspension while loading and spraying. When using a non-emulsifiable oil or another pesticide, add it after the DiPel ES. Do not mix more DiPel ES than can be used in a 2-day period. Rinse and flush spray equipment thoroughly following each use. Selection of fluid to flush the application system will depend on what type of mixture was used during the application period. Use a strainer no finer than 50 mesh in conventional spray systems.

##### 8.2 Spray Volume Recommendations

For conventional aerial applications use at least 3 gallons of total volume per acre in water based sprays, except in the Western U.S. where 5 to 10 gallons is the usual minimum. For ground application, use at least 8



gallons of volume per acre. For Ultra Low Volume (ULV) aerial applications, mix DiPel ES with vegetable or cottonseed oil and apply in a total volume of 1.0-2.25 quarts per acre or apply undiluted.

## 9.0 CONTROL OF EUROPEAN AND SOUTHWESTERN CORN BORERS ON CORN

### Application Rate (all states except California)

Crop	Pest	Pints/ Acre (ground)*	Pints/ Acre (aerial)
✓ Corn: Field Corn Seed Corn Sweet Corn Popcorn Silage Corn	European Corn Borer and Southwestern Corn Borer (First generation population)	1.5-2.5	—
	European Corn Borer and Southwestern Corn Borer (Second generation population)	1.5-2.5	1.5-2.5

\* Apply in 6 to 8 inch band directly over whorls. Refer to table below for over the row rates.

### Fluid Ounces Applied Per 1,000 Row Feet

Row Width	Label Rate/Acre	
	1.5 pts	2.5 pts
30	1.4 oz/1,000 ft.	2.3 oz/1,000 ft.
32	1.5 oz/1,000 ft.	2.5 oz/1,000 ft.
36	1.7 oz/1,000 ft.	2.8 oz/1,000 ft.

### Timing of Application

Applications should be made when young larvae are present for first or second generation corn borers. One application against the first generation of larvae should provide economic control. Two or more applications may be required against second generation borers if there is an extended period of egg deposition.

#### First Generation:

DiPel ES should be applied on seed corn when no more than 15% to 25% of the corn plants show "shot hole" feeding in the whorls.

With irrigated or sweet corn, apply DiPel ES when not more than 25% to 35% of the whorls show feeding signs.

With dryland corn, apply DiPel ES when not more than 35% to 40% of the leaves show "shot hole" feeding signs.

#### Second Generation:

Apply DiPel ES when a field count shows not more than 50 egg masses per 100 plants and the first hatch is taking place. If worm pressures are intense, a second application may be necessary.

Cool weather may cause corn borer larvae to seek protected areas of the corn plant and to reduce the amount of feeding normally done on exposed plant

parts. This alteration in feeding behavior will hamper the effectiveness of DiPel ES.

Contact State and Local Extension Service for specific economic threshold and application recommendations.

### Control of Other Corn Pests (all states except California)

Crop	Pest	Pints/Acre (ground and aerial)
✓ Field Corn, Sweet Corn, Seed Corn, Silage Corn and Popcorn	Corn Earworm	2.0-4.0
	Variegated Cutworm	1.5-2.5
	Webworms	1.5-2.5
	Armyworms <sup>1</sup>	2.0-4.0
	Western Bean Cutworm <sup>1</sup>	1.5-2.5

### Tank Mix Directions for Control of Other Corn Pests

Crop	Pest	Pints/Acre (ground and aerial)
Sweet Corn and Field Corn	Corn Earworm	0.75*-4.0*
	Armyworms <sup>1</sup>	0.75*-4.0*

<sup>1</sup> DiPel ES may be used to control small armyworms and the Western Bean Cutworm (1st and 2nd instar) when populations are light and full coverage sprays are applied. Repeat treatments as necessary. If mature worms or heavy populations are present a contact insecticide should be used to enhance control.

### Directions for Use (\*Tank Mix Only):

DiPel ES can be mixed with esfenvalerate (1.9EC), permethrin (25W, 3.2EC, 25WP), methomyl (90% water soluble powder, 24% liquid, 29% liquid) or methyl parathion (microencapsulated 2 lbs/gallon) for use on sweet corn against armyworms and corn earworm in accordance with the more restrictive of label limitations and precautions. No label dosage rates should be exceeded.

### Timing of Applications:

**Armyworms:** Treat when plants first exhibit feeding signs in the whorl or leaves. Multiple applications at approximately 3 to 5 day intervals may be necessary when populations are heavy. High-spray gallonage (50-75 gallons per acre) is best for effective control.

**Corn Earworm:** Treat every 1 to 3 days or at wider intervals depending on pest pressure, temperature and geographical location. Begin treatments when 5 percent of the upper ears show silk. When populations are heavy, treat when first silk is seen and every 1 to 3 days thereafter until harvest.

## 10.0 APPLICATION RATE FOR COTTON

### EARLY SEASON PROGRAM

#### Pre-squaring stage:

DiPel ES may be used for early season management of *Helicoverpa zea* and *Heliothis virescens* under



conditions of continuous low egg deposition. Use DiPel ES alone at 0.5 pint/acre or in combination with a recommended ovicide, boll weevil sprays, or Pix applications. When egg pressure is moderate to high, DiPel ES should be tank mixed with an ovicide. A spray interval of 5-7 days is recommended for a total of 3 applications, if necessary, especially if continued egg pressure occurs during this period.

#### Pre-bloom stage:

For control of light to moderate populations, use DiPel ES at 0.75 to 2.0 pints/acre in combination with an approved ovicide such as Larvin (thiodicarb). Repeat treatments at 4 to 5 day intervals or as long as necessary to maintain control. Applications should be directed at brown eggs and newly hatched larvae. Larvae should not exceed 2,500 per acre (approximately 4 percent of plants infested) before treatments are initiated. Close scouting is essential for well-timed applications.

#### MID SEASON PROGRAM

Pre-bloom to first mature boll stage: Use DiPel ES at 0.75 to 4.0 pints/acre in combination with 1/2 to 2/3 rate of a recommended synthetic pyrethroid during midseason. Use the lower rates under moderate pressure and increase rates if necessary to maintain control.

#### LATE SEASON PROGRAM

##### Mature bloom boll stage:

Use DiPel ES at 0.75 to 4.0 pints/acre in combination with recommended carbamate or organophosphate insecticides. This product will aid in controlling worms escaping from organophosphate insecticides.

DiPel ES can be mixed with other insecticides in accordance with the more restrictive label limitations and precautions. This product cannot be mixed with any other product having a label which prohibits such mixing.

##### Spray Volumes:

For aerial applications, use a minimum of 3 gallons of total volume per acre in water based sprays except in the Western U.S. where 5 to 10 gallons is the usual minimum. For ground application, use at least 3 gallons of total volume per acre with 3 nozzles per row. For banded applications, use a minimum of 2 nozzles per row with ground sprayer or cultivator. Rates should not be less than 0.5 pint/acre on a broadcast basis. For ULV applications, mix 1 to 2 pints DiPel ES with 1 to 2.5 pints vegetable or cottonseed oil and apply in a total volume of 1.0-2.25 quarts per acre. Adjust the spray system to deliver a fine droplet spectrum. Generally, rotary atomizers produce a finer droplet spectrum for ULV applications.

#### DiPel ES Rate for Cotton (for all states except California)

Crop	Pest	Pints/Acre (ground and aerial)
Cotton* ✓	Tobacco Budworm <sup>2</sup>	1.0-4.0
	Cotton Bollworm <sup>2</sup>	1.0-4.0
	Armyworm <sup>1</sup>	2.0-4.0
	Loopers	1.0-2.0
	Saltmarsh Caterpillar	1.0-2.0

\* For use in California, see the California Crops section of this label.

<sup>1</sup> DiPel ES may be used to control small armyworms (1st and 2nd instar) when populations are light and full coverage sprays are applied. Repeat treatments as necessary. If mature worms or heavy populations are present a contact insecticide should be used to enhance control.

<sup>2</sup> Use DiPel ES to control light to moderate populations of newly hatched worms in pest management programs. Use under close scouting when beneficial insects are active or building. Repeat treatments at 4 to 5 day intervals or as long as necessary and results are acceptable. This product can be mixed with Larvin for use on cotton against tobacco budworm and cotton bollworm in accordance with the more restrictive of label limitations and precautions. No label dosage rates should be exceeded. This product cannot be mixed with any product containing a label prohibition against such mixing. DiPel ES may be used alone for *Helicoverpa zea* and *Heliothis virescens* control only on prebloom cotton where few or no eggs are present. If significant eggs are present, use only in combination with ovicidal rates of Larvin (Larvin is a trademark of Rhone-Poulenc).

#### 11.0 DIPEL ES RATE FOR PEANUTS (for all states except California)

Crop	Pest	Pints/Acre (ground and aerial)
Peanut ✓	Green Cloverworm	1 - 2
	Loopers	1 - 2
	Podworm <sup>1</sup>	1 - 4
	Armyworm <sup>1</sup>	2 - 4
	Velvetbean Caterpillar	1 - 2

<sup>1</sup> DiPel ES may be used to control podworms and armyworms when populations are light to moderate and good spray coverage can be achieved. Use DiPel ES at 1.0 to 4.0 pints/acre (2-4 pints per acre for armyworms) when small larvae first appear. Applications should be made to coincide with egg lay and early instar larvae. Under conditions of higher pressure and rapid plant development, the addition of a contact insecticide in combination with DiPel ES is recommended. Treatments should be repeated as necessary to maintain acceptable control.



## 12.0 DIPEL ES RATE FOR ALFALFA, HAY & OTHER FORAGE CROPS (for all states except California)

Crop	Pest	Pints/Acre (ground and aerial)
✓ Alfalfa (Hay & Seed) Hay & Other Forage Crops*	Armyworms <sup>1</sup>	2 - 4
	Loopers	1 - 2
	Alfalfa Caterpillar	1 - 2
	European Skipper	1 - 2
	Webworm	1 - 2

\* For use in California, see the California Crops section of this label.

<sup>1</sup> DiPel ES may be used to control small armyworms (1st and 2nd instar) when populations are light and full coverage sprays are applied. Repeat treatment as necessary. If mature worms or heavy populations are present a contact insecticide should be used to enhance control.

## 13.0 DIPEL ES RATE FOR SUNFLOWERS (for all states except California)

Crop	Pest	Pints/Acre (ground and aerial)
✓ Sunflowers: oil seed and confectionary	Sunflower Moth <sup>1</sup>	1.5 - 2.5
	Banded Sunflower Moth <sup>1</sup>	1.5 - 2.5

<sup>1</sup> For moderate pest pressure make a single application prior to 75% bloom. A second application, 5 days later, may be necessary to control severe infestations. Treat when larvae are exposed and small.

In Texas, begin treatment when early-instar larvae are present and no more than 20% of the heads are in bloom. Use a spray interval of 4 to 6 days for a total of 3 applications, if necessary, to reduce the worm population to an acceptable level, especially if continued egg deposition occurs during the period.

## 14.0 DIPEL ES RATE FOR OTHER CROPS (for all states except California)

Crop	Pest	Pints/Acre (ground and aerial)
✓ Legume Vegetables such as Beans, Peas, Lentils and Soybeans	Loopers	1 - 2
	Green Cloverworm	1 - 2
	Velvetbean Caterpillar	1 - 2
	Podworms <sup>1</sup>	1 - 4
	Armyworms <sup>1</sup>	2 - 4
	Soybean Loopers	1 - 2
	Saltmarsh Caterpillar	1 - 2

<sup>1</sup> DiPel ES may be used to control small armyworms and/or podworms (1st and 2nd instar) when populations are light and full coverage sprays are applied. Repeat treatment as necessary. If mature worms or heavy populations are present a contact insecticide should be used to enhance control.

Crop	Pest	Pints/Acre (ground and aerial)
✓ Root and Tuber* Crops such as Sugar Beets, Carrots, or Potatoes	Armyworms <sup>1</sup>	2 - 4
	Cutworms	1 - 2
	Diamondback Moth	1 - 2
	Hornworms	1 - 2
	Loopers	1 - 2
	European Corn Borer	1 - 2

\* For use in California, see the California Crops section of this label.

✓ Pome Fruit such as Apple and Pear	Cankerworms	1 - 4
	Codling Moth	1 - 4
	Cutworms	1 - 4
	Stone Fruit such as	1 - 4
	Fall Webworm	1 - 4
	Cherry, Nectarine,	1 - 4
	Leafroller	1 - 4
	Peach, Plum and	1 - 4
	Gypsy Moth	1 - 4
	Prune	1 - 4
	Redhumped Caterpillar	1 - 4
✓ Tree Nuts such as Almond, Filbert, Pecan and Walnut	Tent Caterpillars	1 - 4
	Tufted Apple Budmoth	1 - 4
	Walnut Caterpillar	1 - 4
	Armyworms <sup>1</sup>	2 - 4
	Oriental Fruit Moth	1 - 4
	Peach Twig Borer	1 - 4
	Pecan Nut Casebearer	1 - 4
	Navel Orangeworm	2 - 4
	Hops	2 - 4
	Armyworms <sup>1</sup>	2 - 4
	Loopers	1 - 2

<sup>1</sup> DiPel ES may be used to control small armyworms (1st and 2nd instar) when populations are light and full coverage sprays are applied. Repeat treatment as necessary. If mature worms or heavy populations are present a contact insecticide should be used to enhance control.

✓ Small Fruits and Berries <sup>1</sup> such as Blueberry, Grape, Cranberry, and Strawberry	Spanworm	1 - 2.5
	Gypsy Moth	1 - 2.5
	Blossom Worm	1 - 2.5
	Sparganothis Fruitworm	1 - 2.5
	Fireworm	1 - 2.5
	Cranberry Fruitworm	1 - 2.5
	Armyworms	2 - 4
	Black Cutworm	1 - 2.5
	Looper	1 - 2.5
	Tent Caterpillars	1 - 2.5

<sup>1</sup> Treat when larvae are young and before economic thresholds of damage have been exceeded. If hatch occurs over an extended period of time, multiple application should be considered. Use higher rates when pest pressure is heavy and/or older larvae are present. Tank mixes of DiPel ES plus a low rate of contact insecticide (such as phosmet) registered for use on small fruit and berries may enhance control of heavy populations and large larvae. The use of an approved spreader sticker is recommended.



#### 14.0 DIPEL ES RATE FOR OTHER CROPS (cont'd) (for all states except California)

Crop	Pest	Pints/Acre (ground and aerial)
✓ Small Grains such as Barley, Sorghum, Wheat or Oats	Armyworms <sup>1</sup>	2 - 4
	Variegated Cutworm	1 - 2
	Looper	1 - 2
	Corn Earworm	1 - 4
	Webworm	1 - 2

<sup>1</sup> This product can be used to control small armyworms (1st and 2nd instar) when populations are light and full coverage sprays are applied. Repeat treatment as necessary. If mature worms or heavy populations are present a contact insecticide should be used to enhance control.

Rangeland	Range Caterpillar	.5 - 1
-----------	-------------------	--------

Use in 1 to 2 quarts water per acre against 1st through 4th instar larvae.

#### 15.0 DIPEL ES RATES FOR CALIFORNIA CROPS

Crop	Pest	Pints/Acre (ground and aerial)
✓ Cotton*	Armyworm <sup>1</sup>	2 - 4
	Loopers	1
✓ Alfalfa (Hay and Seed) Hay and Other Forage Crops	Armyworm <sup>1</sup>	2 - 4
	Alfalfa Caterpillar	1 - 2
✓ Root and Tuber such as Sugar Beets, Carrots and Potatoes	Armyworms <sup>1</sup>	2 - 4

\* See the Cotton Section of this label for further use directions.

<sup>1</sup> DiPel ES may be used to control small armyworms (1st and 2nd instar) when populations are light and full coverage sprays are applied. Repeat treatment as necessary. If mature worms or heavy populations are present a contact insecticide should be used to enhance control.

Tree Nuts, such as Almond, Pecan, Walnut and Filbert	Peach Twig Borer <sup>1</sup>	2 - 4
	Navel Orangeworm <sup>2</sup>	2 - 4
Stone Fruit, such as Cherry, Plum, Peach, Prune and Nectarine	Peach Twig Borer <sup>1</sup>	2 - 4

<sup>1</sup> Make two applications during bloom for control of overwintering larvae; the first between popcorn and the beginning of bloom and the second seven to ten days later, but no later than petal fall. Spring sprays (the May spray) directed against first generation larvae should be determined by the use of pheromone traps and degree-day calculations.

Control of second generation larvae requires critical timing and should begin at 1% hull split in almonds and prior to fruit entry in other crops.

<sup>2</sup> Applications may be directed against the spring-hatching larvae by timing based on monitoring of egg traps. Hull split sprays should include two applications: the first at the initiation of hull split or initiation of egg laying following hull split, and the second seven to ten days later.

#### 16.0 APPLICATION RATE FOR SMALLER SPRAY VOLUMES

If Rate is	Use This Amount Per Gallon
1/2 pt./acre or 100 gals.	1/2 tsp.
1 pt./acre or 100 gals.	1 tsp.
2 pts./acre or 100 gals.	2 tps.
4 pts./acre or 100 gals.	4 tps.

#### 17.0 NOTICE TO USER

Seller makes no warranty, express or implied, of merchantability, fitness or otherwise concerning use of this product other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with accompanying directions.





NATIONAL AGRICULTURAL LIBRARY



1023072119